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ASSESSMENT OF CHROMATIC REINTEGRATION TECHNIQUES AND MATERIALS WITH SIMULATIONS ON MOCK-UPS: THE EXAMPLE OF A POLYCHROME GLAZED CERAMIC PITCHER FROM THE COLLECTION OF THE NATIONAL MUSEUM OF SLOVENIA

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ABSTRACT

The glazed ceramic pitcher no. N11519 from the National Museum of Slovenia collection presents empirical research and approaches to conserving damaged paintings by testing conservation materials and various reintegration techniques. Studies of specific pigmented retouching paints describe the retouching practice of glaze-like retouching paints. They have been a part of the diploma thesis entitled *Ways of reintegration the missing polychrome painting on ceramic pitcher* at the Academy of Fine Arts and Design, University of Ljubljana, majoring in Conservation and Restoration of Fine Arts. The reintegration assessment intends to present multilayered paint effects on chromatic reintegration of a large area of reconstructed painting on a ceramic pitcher. A silicone mold was made in the selected area of an extensive paint loss for reintegration samples, from which gypsum casting mock-ups were formed. The practical determination of the chromatic reintegration was to simulate the stratigraphy of the paint layer and the in-glaze method of decorating the pitcher: a white underglaze over which a polychrome painting with overglaze was applied.
The practical goal was to get close to the original painting's color, structure, and texture with differing application modes in lines, dots, liquid strokes, and surface smoothing. The chromatic reintegration tests of a glaze painting were perceived with varied and comminated approaches to applying retouching paint media to gypsum mock-ups. This can be achieved by meticulous scrutiny to review and evaluation a medium in the appropriate solvent. The mock-up assessments showed that the most suitable for the glazed pitcher is chromatic reintegration with dotted hatched, using the retouching colors with urea-aldehyde resin Laropal® A 81. The researched methods and the technique of chromatic reintegration on a ceramic pitcher were presented in the exhibition *In Good Hands: 60 Years of the Department of Conservation and Restoration of the National Museum of Slovenia* (Fig. 7).

Keywords
Restoration; Chromatic reintegration; Materials and techniques; Mock-up testing; Glazed ceramics; Aldehyde resin Laropal® A 81.

1. INTRODUCTION

1.1 The issues of chromatic reintegration

Reintegration might be considered an intervention in the painting concept of a work of art in the color, content, and compositional or spatial conception. Through this research, the National Museum of Slovenia searched for recent materials for the most suitable methodology of

chromatic reintegration on polychrome glazed ceramics. We focus on principles and ethical aspects to find suitable materials and techniques for chromatic reintegration. The development of chromatic reintegration in various retouching media and types of modeling techniques and brush strokes depend on the extensive paint losses. The way of trade with damaged paintings is based on the current understanding of the profession's recommendations, awareness, experience, and technical capabilities that improve the visual impact of the work of art on the general viewer. Despite the greater choice of different retouching paint media to use in conservation-restoration, in some instances, it is difficult to choose the suitable medium and method that would also suit aesthetically. Through practical research about how we retouch paintings, was treated questions on how to preserve the artistic value, aesthetic and historical value in combining material and immaterial aspects with subject-specific and non-subject-specific information. [1]

Due to the technical and technological complexity of the original painting, insufficient material analyses, problems of compatibility of materials and mixtures ratios used, or the very purpose of reintegration, we are often forced to prefer an alternative solution for chromatic reintegration.

1.2 Condition description of the ceramic pitcher no. N11519 before the procedure

The pitcher is decorated in Florentine high renaissance style. The central scene on the pitcher shows the biblical story of Sodom and Gomorrah. It could be classified from the first half of the 18th century until the beginning of the Neo renaissance period in the second half of the 19th century after copying this style was typical. In the faience painting technique, it is usual to build polychromy on a white underglaze, usually in a tin glaze. Microscopic analysis of the paint layer stratigraphy confirmed that the original painting technique was based on the technology of making faience. Before the intervention, several areas of the pottery had paint losses. The most damaged part of the pitcher was the glazed painting, which had cracks over the entire surface and deviated slightly from the ceramic base (Fig. 1). The cracking of a glaze on a fired pot is called crazing—the result of the glaze shrinking more than the clay body in the cooling process. Due to the damage position, a mechanical crack-up through the thump is an assumption on the most convex area of the belly. The pitcher has been conserved and restored in the past, but that has not been documented. Especially noticeable is the larger reintegration on the foot of the pitcher and the traces of gypsum plaster on the contact between the foot and the belly.

Figure 1 – Photo documentation of the ceramic pitcher with inv. No. N11519 before the procedure - the front side with the central painting scene (left) and the side with the paint loss (right).

2. MATERIALS AND METHODS

2.1 The aim of the research with preliminary reintegration mock-ups

Empirical tests of conservation-restoration materials and techniques on the glazed ceramic might be harmful and ethically inappropriate. Therefore, gypsum was used, casting mock-ups for this purpose. To ceramic objects, mock-ups could be copies of a lost part in their entirety or only one element for educational purposes. In our case, mock-ups were made as a reproduction of a segment with a quite significant loss of paint layer on the ceramic pitcher. It allowed technical and methodological approaches, in addition, to reconstructing paints of great optical complexity with a subtle color range. These examples involved the optical gamut from transparent to semi-opaque resin paint media; they require some form of hatched or stippled

application. Rigger brushes with narrower and longer bristles are mandatory to paint fine lines, dots, and detail to reintegrate the lined and dotted hatching techniques. On this wise, was analyzed the visual effects of reintegration and thus selected the most appropriate solutions.

The gypsum mock-ups were made by casting silicone rubber on the pitcher's surface with extensive paint loss. This procedure was decided due to the successful consolidation of the surrounding paint layer of ceramics, as otherwise, the surface could be further damaged. This required comprehensive consideration because of the lead and tin-glazed earthenware production craze. A solution of Paraloid™ B 72 in ethyl acetate has effective penetrating properties and gives an accurate refractive index.[2] Due to the matte appearance of the dried consolidate, the procedure didn't change the brightness and color depth of the glaze painting[i].

Figure 2 – Casting the silicone rubber on the field of the selected surface's damage for making gypsum casting mock-ups.

Before the silicone rubber casting process, the selected field of the damaged painting was further coated with microcrystalline wax, which served as a barrier between the object and the casting materials. The wax was dry superficially removed from the surface after a few minutes. With the help of restorative plasticine positioned on the pitcher's surface as containment walls around the damaged part, the shape of the sample mock-ups was determined when casting the silicone rubber (Fig. 2). After the silicone negative had dried, gypsum was poured even so with the help of plasticine containment walls around the negative to imprint the imitation of the pitcher's damaged painting.
For probationary tests, was made ten gypsum castings. The silicone mold could be helpful in further trials, but the flexibility and elasticity of silicone rubber are questionable in the long run[ii].

The gypsum casting process enabled an accurate low relief imprint of the damaged painting for surface reconstruction. The latter allowed the transfer of repetitive motif patterns in a 1: 1 ratio to the original painting. The contour reconstruction of the painted motif was made by mirroring the decoration from the preserved part of the ceramic body. For this purpose, the thermoplastic foil was heated with a heat gun and placed on the surface of the gypsum mock-ups to achieve the desired concave shape. The contour of the loss motif was drawn on thermoplastic molding foil directly from the pitcher and then transferred through perforation to the damaged area of mock-ups. (Fig. 3).

Figure 3 – Reconstruction of loss motif on a thermoplastic foil to transfer the motif on gypsum mock-ups and the ceramic pitcher.

2.1. Selection of retouching paints and solvents

To imitate the glaze appearance of a painting, a greater color depth of retouching paints is required on ceramics.

Synthetic resins with adequate pigments seem to be the most suitable inorganic materials, as they are resistant to degradation over a more extended period and are more durable. [3][4]. We had several concerns when choosing the suitable material. The product's main ingredients are usually given, while smaller components (stabilizers, plasticizers, emulsifiers, etc.) that perhaps significantly impact long-term stability are rarely mentioned. It is more difficult to obtain complete data on a typical polymer's formulation and properties. Products composed of polymers of the same class can change their properties with the production processes depending on the polymerization used (with additives, solvents, etc.).[5] As a rule, the selection follows those approved and published in professional, scientific papers as suitable for conservation-restoration purposes, which we took into account when choosing materials for the reintegration process. The used materials were compatible with the original and the input materials of the previous conservation-restoration intervention.

The Kremer® Retouching Colors palette, which was tested in the chromatic reintegration of the ceramic pitcher, is similar to the Gamblin® Conservation Colors. They differ in that they give the surface a glossier appearance in the final look. Kremer® Retouching Colors are industrially prepared paints based on photochemically stable urea-aldehyde resins with the trade name Laropal® A81[iii]. Laropal® A 81, produced by BASF, is a synthetic resin dissolved in a mixture of petroleum distillates. Laropal® A 81 belongs to a group of low molecular weight resins whose optical properties are similar to a refractive index to glaze and color depth of the painting. It is often well enough to relate the properties of dispersed pigments and retouching media. The solution selection and ratios of resin determine the color and transparency matching. The retouching paints have good covering power and are easily removable. They are suitable for all types of reintegration techniques. Lower or medium polar solvents are used for diluting such paints. Solvents such as xylene, ethyl lactate, and isopropyl alcohol have assessed this approach to find the appropriate gloss for the color. We used them to evaluate the solubility of such solvents (alternatives are available).

The process solves a restoration treatment of the re-solubility of underlying layers by applying a new layer when building up retouching. Therefore, it has had to develop that lightness of touch needed for successful working with such media. To describe the retouching practice of hatched or stippled application differing layering modes, was assess preparations with the Laropal® A81. Suggested working properties are associated with different solvent-resin-pigment formulations. However, they involve a procedure without the final varnish of the retouching. The appropriate finishing layer was obtained with the chromatic reintegration itself.

The solvent xylene (a common solvent as a paint thinner), ethyl lactate, and isopropyl alcohol (fewer toxic alternatives) were used, showing that the xylene was used to compare and assess the visual difference between the surface gloss and light reflectance. The resin solutions have been established by using (e.g., turquoise fluid color), and thereby the aesthetic consequences for dried films have been finally analyzed.

To perform the procedure of chromatic reintegration, it's essential to have adequate and stable lighting for the reintegration to match the polychrome glaze of the enameling pottery. It adapts to the optical properties and color temperature of the light at which the object is exhibited (i.e., exhibition light). We used photographic light to set color temperature values since various light temperatures in restoration workshops appear visually different from exhibition spaces. This was important when retouching in a turquoise glaze colorant, where the effect of metamerism with variations between a more warm or cold hue is more pronounced[iv].

The transparency of the paint application to dry paint depends on the refractive index of pigments and binder, granulation, and pigment concentration. These parameters also depend on the amount of light reflected from the surface. When searching for suitable pigments for chromatic reintegration on the pitcher in question, was used pigments similar to those used in the original painting. Most pigments correspond to historical ones, both in pigment granulation and composition. We started from traditional pigments, which corresponded to the initial period and are useful for painting ceramic products.[6] (Table 1)

The hue, color strength, and opacity or transparency are noticeably dependent on our ability to disperse the paint medium. In doing so, some pigments may be coarser-grained or lack the required degree of transparency. They

often need a larger amount of sorption capacity of binder, which can cause premature usually yellowing. Their transparent ability varied between concentrations from pigment to pigment—the stratigraphy of the original layers conditions the use of translucent or covering paints. The paint may be covering the substrate while being translucent in the last layer. The smaller the pigment grains, the greater the degree of transparency and closer to each pigment's optimal size. Inorganic pigments with larger prime particles and a higher reflective index give more opaque paints. Since each pigment has a different binder requirement, depending on the amount of pigment or its specific weight, we see advantages in using such retouching paints. [7] [8] The choice of material has been determined, considering hue, saturation, brightness, texture, smoothness, thickness, and refractive index.

Table 1 – The Kremer® Retouching Colors in Laropal® A 81 were used for:

Brown paint:	**1st layer** it. natural hay (4040092);	**2nd layer** it. natural umbra (4061292)	**3rd layer** manganese black (4750092)
Turquoise paint	**1st layer** malachite (1034592), titanium white (4620092);	**2nd layer** cobalt turquoise (4576092), spinel black (4570092);	**3rd layer** green earth from Verona (4082192), burnt umbra (4070092).

Yellow paint	**1st layer** titanium white (4620092), it. gold ocher (4022092)	**2nd layer** Neapolitan yellow (4312292)

2.2. Chromatic reintegration techniques

The variable chromatic reintegration on the trial area of mock-ups followed the stratigraphy of the pitcher's polychrome paint layers. On the in-glaze, the underglaze-painting with the overglaze finish was built on the lead-enameled glaze, which requires a third firing[v]. [9] This was intended to mimic a layer of translucent glaze, which is essential for the traditional technique of making faience pottery. Therefore, for the chromatic reintegration assessment, all mock-up fields were first painted brown, also in hatched or stippled technique, to imitate the ceramic base. Then followed the imitation of white tin-enameled underpainting, painted in three layers with calcium carbonate (no. 5849092) and cream white (no. 4600092) of Kremer® Retouching Colors in 20% (w/w) solution of Laropal® A81 [10] with a combined technique of lined and dotted hatching technique.

Due to the optically specific turquoise tone, the basic color, especially in the upper layer of the painting, was mixed on the palette concerning the age signs in the glaze and cracks on the surface. Firstly, we look for the appropriate tone for damages to the painting, while in the second, we look for light and tonal differences of the parts of the painting from the surroundings for each damage separately. The preparation of the samples was followed by the central part of the assessment, which included the application of glaze turquoise and yellow tones for the background technique on mock-ups in a liquid application, dashing, dotting, and combinations used as a base or undertone to mimic the motif.[11] Depending on the artwork, this reintegration assessment might be used in different paint application techniques to suit finishing coats. In the case of a minor loss field alone, this methodology pushes the damage into the background of the painting.

To achieve a glossier surface was tried to smooth the reintegrated surface with the heating spatula over the siliconized foil. The shades were applied to the trial area of gypsum mock-ups in short strokes with minimal color input. We perform tests of gliding the resin paint media accurately leveling with the original level of the painting (Fig.4, 4th row). With which it merged as it would if the surface were sealed. Alon, this technique noticeably reduces the visibility of the damage (Fig.4, 4th row).

3. RESULTS AND DISCUSSION

3.1 Results

The assay of chromatic reintegration in lines, dots, fluid strokes, and combinations was assessed with gypsum mock-ups. In chromatic reintegration of the surface damage on several mock-ups (Fig. 4), the stain painting technique in an appropriate transparent tone, we tried to imitate the painted motif and improve the readability of the original painting. The reintegration mimics the glazed appearance of the painting by increasing the medium concentration and completely imitating the motif. By imitating repetitive decorative grotesque motifs with stylized birds and plants, we faced an issue

of the re-solubility of underlying layers on applying a new layer when building up retouching and have had, therefore, to develop that lightness of touch needed for successful working with such media. This has been considered to the surface properties of a layered motif have been painstakingly modeled, especially as they relate to reflection direction and strength. The reconstruction of the motif was performed with fine modeling strokes, which gradually restored the appearance of the whole with the original surface. In the line hatching technique on probation mock-ups, the overlying paint layer follows the method of applying the technique in the direction of the brush strokes of the painting. In the dotted hatching technique probations, the construction of the reintegrated paint layer is shown with minimal color input in lighter and slightly cooler color tones.

The retouching paint was applied with fine short strokes without unwanted melting of the lower coats despite using the same solvent. Full coverage or different levels of transparency to a fluid color was achieved by adding the appropriate viscosity of the medium. Slightly more time for investigation and assay is required to find the suitable gloss that matches the appearance of the overglaze on the original painting.

With the addition of diluent solvent Laropal® A81, we could maneuver the final appearance of the gloss of the retouching paint. This considers the evaporation of the solvent and the drying time, which vary from color to color. When using a faster-evaporating solvent with higher polarity, in our case, isopropyl alcohol, the application usually is faster. The strokes of the brush are sharp while being the final appearance of dried paint semi-glossy or matte. With lower or medium polar solvents, solvent evaporation is slower, allowing greater flexibility of use. The latter allows us a longer time interval from preparation to applying paint. The brush strokes are softer, and the paint dries longer and gives a higher sheen to the surface. Ethyl lactate has proven to be a suitable solvent for diluting aldehyde resin-based paints, as it allows uniform application of paint and retouching of colors on the palette. The sufficient concentration chosen to achieve the appropriate gloss of the paint was already at a ratio of 20% (w/w) solution of Laropal® A81 in ethyl lactate.

Figure 4 – The results of chromatic reintegration testing on mock-ups: (1st row) transparent and glaze appearance of the color and motif in a stain painting technique. (2nd row) Color and motif reconstruction in line strokes to a hatched or stripped approach and (3rd row) in a dotted hatching technique. The smoothed surface of the color reconstruction (4th row) the achieved with a heating spatula and siliconized foil.

In the hatched or stippled technique, the pointillistic effect of the color reflection and final gloss can be adapted by applying resin paint due to diffuse reflection.

When searching for an appropriate solvent, it was visually assessed that xylene didn't significantly increase the gloss surface intensity compared to ethyl lactate. In addition, it has the advantage of being an organic solvent that is biodegradable and non-toxic. [12] It has low surface tension, which allows even application of paint and preparation of retouching color on the palette[vi].

The practical experience proved that isopropanol is suitable for less sheen glazed surfaces.

The mock-up probation appears that the most suitable for the glazed ceramic is chromatic reintegration with dotted hatching. By arranging the dotted structure in warm-cool and dark-light contrast color tones and increasing the medium concentration, it was possible to achieve the multi-layered paint effects of the glazed painting. The chromatic reintegration was in such a manner successfully carried out on the ceramic pitcher (Fig. 5).

3.2 Discussion

The use of the Kremer® Retouching Colors combined with, e.g., urea aldehyde resin Laropal® A81 seems practical in museum work and handling. The study encourages the preparation of paints according to the ceramics period in advance. It makes sense to treat objects systematically, observe them in the longer term, and reduce measures to reach quality approaches with minimal interventions. We often encounter aesthetically disturbing color and tonal changes in the museum practice of previous reintegration of ceramic objects. The dot or line hatching technique supports the ability to correct a retouch and improve the tone-altered reintegrated fields that aren't removed. In the appropriate color groups, their appearance might be improved and unified with the original surface of the paint layer with a repetitive stroke. The reintegration approach with the lined and dotted hatching technique seems to be the most appropriate process, as it is perceived as the optical effect of warm and cold and lighter and darker color strokes. The completed part of the chromatic reintegration should look slightly cooler and lighter than the surrounding color of the original. As a rule, first, a cool and then a warm tone of paint is applied. With application by superposition, the paint layers are placed one on top of the other until their right color effect is achieved. The wise of additive application, the appropriate color tone according to the glaze colorants is mixed on a palette and then applied as one layer. This procedure is not solely about the original structure but also about the temporal appearance corresponding to the original surface. Ideally, the reintegration matches the construction of the surrounding paint layer [13].

The surface appearance, texture, transparency, and gloss are essential in matching the paint layer's glaze colorants on the artwork. Using a hatched or stripped technique, the surface differs slightly from the original smooth and gloss of the glaze in structure and texture. Especially the nature of the painting of the pitcher requires a high sheen of a reintegrated surface. Therefore, the resin's refractive index is critical in the final appearance of the chromatic reintegration. The characteristic of the film was determined by the glass transition temperature (Tg), which is essential when choosing a binder that acts as a final varnish of the chromatic reintegration.

During our initial testing of different paints and varnishes based on acrylic, alkyd, and aldehyde resins, which were further diluted, if necessary, they proved the weakest fitting in integrating the loss polychrome painting of glazed ceramics. To adjust these according to the National museum's requirements. We research commonly used materials for pigmented retouching paints of glazed ceramics and adapt them. Included in the reintegration assessment was Epoxy resin Araldite® CY 220-1 served primarily as a reintegration varnish for Liquitex acrylic color, as it was intended to mimic the final transparent lead overglaze. This method cannot melt the lower layers or be removed separately from reintegration. There is a change in the color brightness and visual effect after applying a final varnish on the retouch. It changes the turquoise tone to a warmer and brighter hue, making it hard to predict. Despite numerous trials of the turquoise hue, we were unsatisfied with the results. The same development of the turquoise tue we had from fluid to dry paint with Amsterdam's water-based glaze color. Still, according to the experience of experts in the museum, they are photochemical instability (not light-fast and consequently turn yellow quickly).

For reintegration of turquoise fluid color, the dotted hatching technique was also used in the low layering to mimic the in-glaze of decorating pottery, instead of perhaps a visually more appropriate fluid application to execute. For a liquid appearance of the applied paint, retouching color from the bottle with the tip of the needle was added and mixed with enough resin to correspond to a lubricating and enough transparent solution. Before the paint at the palette dries, a minimal addition of a diluent is sufficient. Thus, simultaneously reducing the possibility of premature yellowing or discolorations of reintegration. Still, concerns about the long-term behavior of modern retouching are reduced if they are sandwiched between isolating, and the long-

Figure 5 – Chromatic reintegration of the large reconstructed area with multilayered paint effects of the painting on a ceramic pitcher.

Figure 6 – The-reintegrated missing painting on the ceramic pitcher.

term properties of those varnish layers are known. The physical function of such retouching is to form a temporary resin film, while the content identity of the retouching media may change through interaction with pigments. The reintegrated painting on the ceramic pitcher is mainly based on additive mixing of pigments in the finishing layer (excl., varnish layer.).

In reintegration with glaze appearance in a stain painting technique, we are usually forced to paint the motif in one go, which means we don't have many chances for corrections. Unlike the dot or line hatching technique, upgrading the painted motif is possible. The latter allows for current and subsequent modifications or revisions to complete reintegration and imitates the overglaze decoration of the pottery more accurately. We had more time planning the application method and scrutinizing the applied paint's visual effect during the work.

Figure 7 – The researched methods and techniques of chromatic reintegration on a ceramic pitcher presented as a part of the exhibition *In Good Hands*.

4. CONCLUSIONS

Conservators-restorers have slightly different retouching techniques and application modes, even within a single institution such as the National Museum of Slovenia. The conservation-restoration practice in

the museum; by using retouching paints, the mimetic reintegration or tratteggio is the most often used on ceramic. Therefore, we were attentive to an intervention of chromatic reintegration, which would differ only to a small extent from the original painting of the ceramic pitcher. In the preliminary research on mock-ups, we decided on the most suitable method of chromatic reintegration on the museum's pitcher. Through the dotted hatching technique and urea-aldehyde resin paints, we agreed on the approach to the motif of the original painting accurately (Fig. 6).

Preliminary tests on mock-ups significantly reduce the possibility of reintegrations misapprehending the original. Although conservators-restorers often haven't enough time for such comprehensive and systematic mock-up assessments, it makes sense in the case of important artifacts when introducing new materials and techniques or improving conservation skills. However, it is essential to point out that retouching additions to the missing parts of the subject are intended to recreate the artist's work. Still, simultaneously they might perceive them as the individual conservator-restorer's interpretations. In connection with deciding what to exhibit and how an exhibition should affect us, the theme of reintegration reflects the current prevailing museum exhibition policy, which may change over time.

REFERENCES

[1] APPELBAUM, B. (2013), *Conservation treatment methodology*, New York: Routledge.
[2] ARSLANOGLU J. and LEARNER T. (2010). The evaluation of Laropal A81: Paraloid B-72 polymer blend varnishes for painted and decorative surfaces – appearance and practical considerations. *The Conservator. Vol. 25, Issue 1 (2001)*, 62-72.
[3] ELLISON, R., SMITHEN, P. & TURNBULL, R., (Eds.) (2010). *Mixing and Matching. Approaches to Retouching Paintings*. London: Archetype.
[4] MATTEINI M., ROCCO M. & MOLES A. (2017). *Chemistry for restoration: painting and restoration materials*, Florence: Nardini Editore.
[5] GOSAR HIRCI B., MOČNIK RAMOVŠ L. (2015), Use of retouching colors based on resin binders – from theory into practice. In: *3rd International meeting on retouching of cultural heritage* (RECH3); Porto, 45, 46
[6] Kremer pigmente, *Für Keramikfarben geeignete Pigmente*, Available at: https://www.kremer-pigmente.com/media/pdf/keramikliste.pdf [14 January 2022].
[7] Kremer pigmente, *Overview of hazardous substances / Content list 14904 Set: Kremer Retouching Colors in Laropal® A 81*, Available at: https://www.kremer-pigmente.com/en/shop/ready-made-colors/14904-set-kremer-retouching-colors-in-laropal-a-81.html [14 January 2022].
[8] Kremer pigmente, *14904 KREMER Retouching Colors in Laropal A 81: Kremer-made*, Available at: https://www.kremer-pigmente.com/elements/resources/products/files/14904e.pdf [14 January 2022].
[9] AIC Wiki: *Ceramics.* Available at: https://www.conservation-wiki.com/wiki/Ceramics [14 January 2022]
[10] BASF, *Industrial Coatings: Technical Data Sheet Laropal® A 81*. Available at: https://dispersions-resins-products.basf.us/files/technical-datasheets/Laropal_A_81_August_2017_R3_IC.pdf [14 January 2022].
[11] ROEMICH H. and FAIR L. (2016). Recent advances in glass and ceramics conservation 2016. *International Council of Museums – Committee for Conservation (ICOM-CC),* 75-107
[12] Science direct, *Ethyl Lactate*. Available at: https://www.sciencedirect.com/topics/engineering/ethyl-lactate [14 January 2022].
[13] NICOLAUS, K., (1999). *Restoration of Paintings*, Cologne: Könemann.

NOTES

[i] In general, we would, in the process, obtain a slightly higher stickiness with a lower Tg of the consolidation.

[ii] K31 silicone rubber, which hardens with the additives of 2.5% C88 catalyst or Tixo-Quick.

[iii] Laropal® A81 is a condensation product of urea and aliphatic aldehydes. Based on the surface appearance properties, a possible alternative also might be Laropal A ® 101 or Laropal® A-8L.

[iv] The light on the transparent reintegration penetrates to the depths (i.e., deep light) where it is partially absorbed.

[v] Lead glaze becomes opaque by the addition of tin oxide.

[vi] The industry pigment preparations are combined with the medium by grinding with a small palette knife or ground glass muller on the ground glass surface.

